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## INSTRUCTIONS FOR USE OF THE DIFFERENTIAL DYE TEST FOR ESTIMATING MATURITY OF COTTON<sup>1/</sup>

Preparation of samples. Samples of cotton are carefully selected to be representative of the entire lots of raw stock. It is preferable, for comparative purposes, to dye all of the samples in the same bath at the same time. A convenient weight of sample is 3 to 5 grams. If only one sample is to be dyed, it is loosely enclosed in a small bag made from bleached open-mesh gauze (28 x 24 thread count). If a number of samples are to be dyed, a convenient arrangement for handling throughout treatment is to place 4 to 6 of the samples within gauze, about 5 x 18 inches. A seam is sewed around each sample to keep it separate. Any practicable number of such strips can be dyed simultaneously.

Identification of samples. A coding system is used to identify the prepared strips and the samples within each strip. The system is based upon the number and the position of knots tied in a cotton cord attached at the end of the strip. The number of knots in either or both ends of the cord differentiates between different strips. The position of the sample with respect to the end at which the cord is attached identifies individual samples within each strip.

Apparatus and materials. The differential dye test can be made with conventional laboratory apparatus. Two commercial direct dyestuffs are required: Diphenyl Fast Red 5BL Supra I (Geigy) (C. I. No. 278) and Chlorantine Fast Green BLL (Ciba) (Prototype 425). Stock solutions of the dyes are used having concentrations of 5 grams per liter for the red and 10 grams per liter for the green.

The sodium chloride required for the dyebath is made up for convenience into a solution containing 10 grams per liter.

Method. After weighing, the cotton is entered without prewetting into a boiling bath, made up with distilled water to 40 times the weight of cotton, containing 1.2% red dye and 2.8% green dye, calculated on the weight of all the cotton, samples plus gauze. The samples are kept submerged until thoroughly wetted.

After dyeing for 15 minutes at the boil the cotton is lifted out and 2-1/2% of its weight of C. P. sodium chloride is stirred into the dyebath. The required quantity of salt is added in the form of a 1% solution in order to compensate for the reduction of the dyebath caused by evaporation.

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<sup>1/</sup> Report of a study made under the Research and Marketing Act of 1946.



The cotton is re-entered for 15 minutes, then lifted again, and a second portion of 2-1/2% sodium chloride is added. The dyeing proceeds at the boil to a total of 45 minutes when the cotton is lifted, squeezed, cooled, and washed well in two changes of cold, distilled water in the proportion of 50 parts to 1 of cotton. After squeezing out of excess water, the matted fibers are pulled apart while still in the gauze and are dipped into vigorously boiling water (50:1) for exactly 30 seconds, with stirring, then lifted, and the excess liquor is removed as rapidly as possible: for example, by squeezing in a hand wringer, centrifuging, or pressing on a wire screen. The time of contact of the dyed material with the boiling water is very critical with respect to the final shade; and variations in this manipulation are chiefly responsible for inaccuracies in the reproduction of dyeings. For best results it is advisable to handle each strip separately for this operation to insure rapid and uniform removal of the hot water. The hot washing is not in accordance with usual direct dyeing practice and is really a differential stripping. It removes excess red dye but relatively little green, thus eliminating grayness and resulting in more clearly defined colors, especially the green.

After final wringing the dyeings are removed from the gauze bags, fluffed, and allowed to dry in the open air or with moderate heat. Mature cotton in its natural state will have colored to a pronounced red. Thin-walled or immature cotton will be gray-green to a distinct green.

Close attention to all details is recommended, although extensive experience may indicate that the procedure can be simplified somewhat without detracting from the results. It is advisable, however, to use the exact dyes specified and to use distilled water for all solutions and for the dyeing. Slight variations between different lots of the same dye may cause less than the optimum contrast in color obtained, and necessitate revision of the formula.

Estimation of maturity by color. The absolute or relative maturity is determined from the overall color of the dyed sample, the reddest being of greatest maturity. The natural occurrence of differently colored tufts of fibers in a raw stock sample makes critical comparison difficult. A simple and effective method of obtaining a uniform shade is to cut the sample (about 3 grams) to a near powder (20-mesh screen) in a Wiley mill. The cut cotton is then dispersed in a 40:1 volume of water containing 1% of an adhesive (sodium carboxymethyl cellulose) and filtered by suction on an 80-mm. coarse fritted disc funnel. The cotton is removed from the funnel by air pressure and dried in the form of a smooth flat pad. A gummed label is placed on the rough side for identification of the sample. A series of such pads can usually be placed in order of color or maturity by visual examination or the percentage maturity estimated by comparisons with a suitable color scale calibrated in terms of maturity.



Sources of Supply of Chemicals and Apparatus Used with the  
Differential Dye Test<sup>2/</sup>

Chemicals and supplies:

Diphenyl F. Red 5BL (Supra I): Geigy Co., Inc., 89-91 Barclay St.,  
New York, N. Y.  
Chlorantine F. Green BLL: Ciba Co., Inc., 627 Greenwich St.,  
New York 14, N. Y.  
Sodium chloride C. P.: Any chemical supply company.  
Sodium carboxymethyl cellulose (low viscosity) ("Carbose D"),  
Wyandotte Chem. Corp., Wyandotte, Mich.  
Bleached 28 x 24 gauze and cotton cord.

Apparatus:

Beakers, preferably stainless steel. Capacities: 400 ml., 1200 ml.,  
2000 ml., and 3300 ml.: Harshaw Chemical Co., 244 Main St.,  
Cincinnati, Ohio.  
Hotplate (1200 watt): Any chemical supply company.  
Triple beam balance (cap. 1011 grams sensitivity 5 cg.): Central  
Scientific Co., 1700 Irving Park Road, Chicago 13, Ill.  
Scissors, needle, and thread, or sewing machine, household-type.  
Beaker tongs and crucible tongs.  
Stirring rods and spatulas or spoons.  
Graduated cylinders - 5, 10, 25, 50, 100 and 500 ml.: or automatic  
burettes (screw-top-acid bottle-type, 100 ml. capacity in 1-ml.  
graduations): Harshaw Chemical Co., 244 Main St., Cincinnati, Ohio.  
Timer (with second hand) or stop watch.  
Coarse fritted-disc filter funnel, Buchner type, 150 ml. capacity with  
suction flask: Any chemical supply company.  
Laboratory Wiley Mill (Intermediate Model): Arthur S. LaPine & Co.,  
121 W. Hubbard St., Chicago 10, Ill.  
Clothes wringer: or centrifuge.

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<sup>2/</sup> The mention of trade products does not imply that they are endorsed  
or recommended by the Department of Agriculture over similar products not  
mentioned.

